CLAIMS

1. A method for ablating tissue in an organ inside a body of a subject, comprising:

bringing a probe inside the body into a position in contact with the tissue to be ablated;

measuring one or more local parameters at the position using the probe prior to ablating the tissue;

displaying a map of the organ showing, based on the one or more local parameters, a predicted extent of ablation of the tissue to be achieved for a given dosage of energy applied at the position using the probe;

applying the given dosage of energy to ablate the tissue using the probe;

measuring an actual extent of the ablation at the position using the probe subsequent to ablating the tissue; and

displaying the measured actual extent of the ablation on the map for comparison with the predicted extent.

2. The method according to claim 1, wherein bringing the probe into the position comprises using a position sensor in the probe to determine coordinates of the probe at the position in which the probe is in contact with the tissue.

3. The method according to claim 2, wherein measuring the one or more local parameters comprises measuring at least one of a penetration depth of the probe in the tissue and an orientation angle of the probe relative to the tissue, using the position sensor.

4. The method according to claim 2, wherein displaying the map comprises bringing the probe into contact with

the tissue at multiple positions inside the organ, and recording the coordinates of the probe at the multiple positions in order to generate the map.

5. The method according to claim 4, wherein displaying the map further comprises measuring electrical potentials at the multiple positions, and showing an indication of electrical activity on the map, based on the measured electrical potentials.

6. The method according to claim 1, wherein measuring the one or more local parameters comprises sensing ultrasonic waves reflected from the tissue using one or more transducers in the probe.

7. The method according to claim 6, wherein sensing the ultrasonic waves comprises assessing a propagation speed of the ultrasonic waves in the tissue, so as to estimate a temperature of the tissue.

8. The method according to claim 6, wherein sensing the ultrasonic waves comprises assessing blood flow responsively to the reflected ultrasonic waves.

9. The method according to claim 6, wherein measuring the actual extent of the ablation comprises sensing the ultrasonic waves reflected from the tissue using the one or more transducers after applying the given dosage of the energy.

10. The method according to claim 1, wherein measuring the one or more local parameters comprises measuring an orientation angle of the probe relative to the tissue, and wherein displaying the map comprises predicting the extent of the ablation responsively to the orientation angle.

11. The method according to claim 1, wherein measuring the one or more local parameters comprises measuring at least one local parameter selected from a list of the local parameters consisting of a penetration depth of the probe in the tissue, an electrical impedance between the probe and the tissue, a temperature of the tissue and a flow of blood associated with the tissue, and wherein displaying the map comprises predicting the extent of the ablation responsively to the at least one factor.

12. The method according to claim 1, and comprising adjusting the dosage of the energy responsively to the map.

13. The method according to claim 1, wherein applying the given dosage comprises transmitting radio frequency (RF) energy into the tissue through an electrode fixed to the probe.

14. The method according to claim 1, wherein applying the given dosage comprises ablating a succession of mutually-adjacent sites in the tissue, and wherein displaying the measured actual extent of the ablation comprises providing a visual indication of overlap between the sites.

15. The method according to claim 1, wherein the organ comprises a heart, and wherein the probe comprises a catheter.

16. A method for ablating tissue in an organ inside a body of a subject, comprising:

bringing a probe inside the body into contact with the tissue to be ablated;

measuring a position and orientation of the probe relative to the tissue with which the probe is in contact;

predicting an extent of ablation of the tissue to be achieved for a given dosage of energy applied by the probe, responsively to the measured position and orientation; and

applying the given dosage of energy to ablate the tissue using the probe.

17. The method according to claim 16, wherein measuring the position and orientation comprises determining location and orientation coordinates of the probe using a position sensor in the probe.

18. The method according to claim 17, wherein the position sensor comprises one or more sensor coils, and wherein determining the coordinates comprises sensing an externally-applied magnetic field using the sensor coils in order to determine the coordinates.

19. The method according to claim 17, wherein measuring the position and orientation comprises bringing the probe into contact with the tissue at multiple positions inside the organ, and recording the coordinates of the probe at the multiple positions in order to generate a map of the organ, and determining the orientation angle of the probe relative to the tissue using the map.

20. The method according to claim 19, wherein determining the position and orientation further comprises determining a depth of penetration of the probe into the tissue, based on the coordinates of the probe and on the map, and wherein predicting the extent of the ablation comprises estimating the predicted extent of the

ablation responsively to the depth of penetration and the orientation angle of the probe.

21. The method according to claim 16, wherein predicting the extent of the ablation comprises measuring at least one local parameter selected from a list of local parameters consisting of an electrical impedance between the probe and the tissue, a temperature of the tissue and a flow of blood associated with the tissue, and estimating the predicted extent of the ablation responsively to the at least one local parameter.

22. The method according to claim 16, and comprising adjusting the dosage of the energy responsively to the map.

23. The method according to claim 16, wherein applying the given dosage comprises transmitting radio frequency (RF) energy into the tissue through an electrode fixed to the probe.

24. The method according to claim 16, wherein the organ comprises a heart, and wherein the probe comprises a catheter.

25. Apparatus for ablating tissue in an organ in a body of a subject, comprising:

a probe, which is adapted to be inserted into the body so as to contact the tissue to be ablated at a desired position in the organ, the probe comprising:

at least one sensor, which is adapted to measure one or more local parameters at the position prior to and after ablating the tissue; and

an ablation device, which is adapted to apply a given dosage of energy to the tissue so as to ablate the tissue;

a display, which is adapted to display a map of the organ; and

a controller, which is adapted to generate the map showing, based on the one or more local parameters measured by the at least one sensor, a predicted extent of ablation of the tissue to be achieved for the given dosage of energy, and an actual extent of the ablation determined subsequent to ablating the tissue, for comparison with the predicted extent.

26. The apparatus according to claim 25, wherein the at least one sensor comprises a position sensor, which is adapted to provide an output indicative of coordinates of the probe within the body.

27. The apparatus according to claim 26, wherein the controller is adapted, responsively to the output of the position sensor, to determine at least one of a penetration depth of the probe in the tissue and an orientation angle of the probe relative to the tissue, and to predict the extend of the ablation responsively to the at least one of the penetration depth and the orientation angle.

28. The apparatus according to claim 26, wherein the controller is adapted to generate the map by processing the output of the position sensor as the probe is brought into contact with the tissue at multiple positions inside the organ.

29. The apparatus according to claim 28, wherein the at least one sensor further comprises an electrical sensor,

which is adapted to measure electrical potentials at the multiple positions, and wherein the controller is adapted to provide an indication of electrical activity on the map, based on the measured electrical potentials.

30. The apparatus according to claim 25, wherein the at least one sensor comprises one or more ultrasonic transducers, which are adapted to transmit ultrasonic waves into the tissue and to generate an output signal responsively to the ultrasonic waves reflected from the tissue.

31. The apparatus according to claim 30, wherein the controller is adapted to measure a propagation speed of the ultrasonic waves in the tissue responsively to the output signal from the one or more ultrasonic transducers, and to estimate a temperature of the tissue based on the propagation speed.

32. The apparatus according to claim 30, wherein the controller is adapted to assess blood flow in the tissue responsively to the output signal from the one or more ultrasonic transducers.

33. The apparatus according to claim 30, wherein the controller is adapted to determine the actual extent of the ablation based on the output signal from the one or more ultrasonic transducers after applying the given dosage of the energy.

34. The apparatus according to claim 25, wherein the controller is adapted to determine an orientation angle of the probe relative to the tissue, and to predict the extent of the ablation responsively to the orientation angle.

35. The apparatus according to claim 25, wherein the one or more local parameters comprise at least one of a penetration depth of the probe in the tissue, an electrical impedance between the probe and the tissue, a temperature of the tissue and a flow of blood associated with the tissue.

36. The apparatus according to claim 25, wherein the controller is adapted to adjust the dosage of the energy responsively to the map.

37. The apparatus according to claim 25, wherein the ablation device comprises an electrode, which is adapted to apply radio frequency (RF) energy to ablate the tissue.

38. The apparatus according to claim 25, wherein the probe is adapted to ablate a succession of mutually-adjacent sites in the tissue, and wherein the controller is adapted to provide a visual indication of overlap between the sites.

39. The apparatus according to claim 25, wherein the organ comprises a heart, and wherein the probe comprises a catheter.

40. Apparatus for ablating tissue in an organ inside a body of a subject, comprising:

a probe, which is adapted to be inserted into the body so as to contact the tissue to be ablated, the probe comprising:

a position sensor, which is adapted to generate an output indicative of a position and orientation of the probe relative to the tissue with which the probe is in contact; and

an ablation device, which is adapted to apply a given dosage of energy to the tissue so as to ablate the tissue;

a display, which is adapted to display a map of the organ; and

a controller, which is adapted to compute, based on the position and orientation of the probe, a prediction of an extent of ablation of the tissue to be achieved for the given dosage of energy, so as to enable the dosage to be adjusted responsively to the prediction.

41. The apparatus according to claim 40, wherein the position sensor comprises one or more sensor coils, which are adapted to generate the output indicative of the position and orientation responsively to an externally-applied magnetic field.

42. The apparatus according to claim 40, wherein the controller is adapted to generate a map of the organ by processing the output of the position sensor as the probe is brought into contact with the tissue at multiple positions inside the organ, and recording position coordinates of the probe at the multiple positions.

43. The apparatus according to claim 42, wherein the controller is adapted to determine an orientation angle of the probe relative to the tissue using the map.

44. The apparatus according to claim 43, wherein the controller is adapted to determine a depth of penetration of the probe into the tissue, based on the position coordinates of the probe and on the map, and to predict the extent of the ablation responsively to the depth of penetration and the orientation angle of the probe.

45. The apparatus according to claim 40, wherein the probe comprises a sensor, which is adapted to measure at least one local parameter selected from a list of local parameters consisting of an electrical impedance between the probe and the tissue, a temperature of the tissue and a flow of blood associated with the tissue, and wherein the controller is adapted to predict the extent of the ablation responsively to the at least one local parameter.

46. The apparatus according to claim 40, wherein the controller is adapted to adjust the dosage of the energy responsively to the map.

47. The apparatus according to claim 40, wherein the ablation device comprises an electrode, which is adapted to apply radio frequency (RF) energy to ablate the tissue.

48. The apparatus according to claim 40, wherein the organ comprises a heart, and wherein the probe comprises a catheter.